Principles of Environmental Restoration

Principle 2 - Problem Identification and Definition

Principle 2

Clear, concise, and accurate problem identification and definition are critical

- Session objectives
  - Explain why accurate problem identification and definition are important
  - Be able to write an environmental restoration problem statement
  - Be able to modify a problem statement as information is received during an investigation and action

Problem definition occurs at all levels on which environmental restoration activities occur:

•Sitewide: What is the focus of my overall site strategy and how should I organize my resources to investigate and remediate areas?

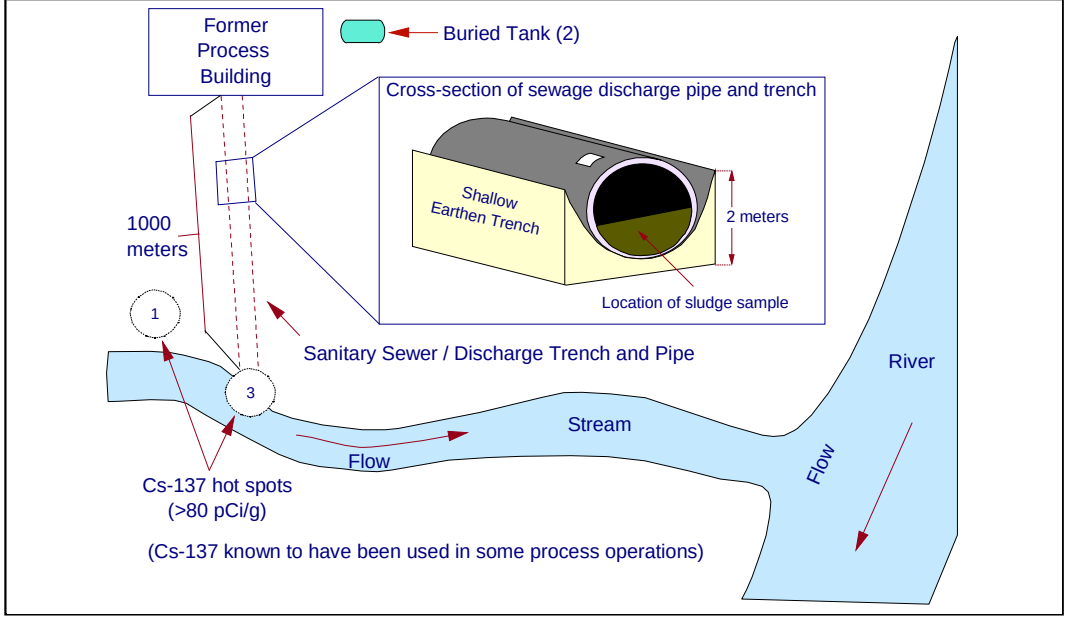
•Within pre-defined groups of units or operable units: What are the problems that exist?

•At a release site or SWMU: What is the problem statement for each problem that is identified?

In practice, problem identification is integrated with the other principles - identifying response actions, managing uncertainty, and creating an effective core team

The core team is ultimately responsible and accountable for problem definition

What is the problem(s)?



Environmental restoration activities are driven by two key questions:

- Do we have a problem?
- If yes, what should we do about it?

This module focuses on the first question.

What is a problem?

- A problem is a site condition posing real or potential unacceptable risk, or a condition that the core team determines requires a response

Problems, by our definition, require a response - some action, either interim or final, taken to reduce/eliminate the potential for exposure

Situations that core teams determine do not require a response are not problems. Note that uncertainty may exist as to whether a problem exists; this represents a data gap. However, defining whether a problem exists is a critical initial activity and often the focus of investigation activities

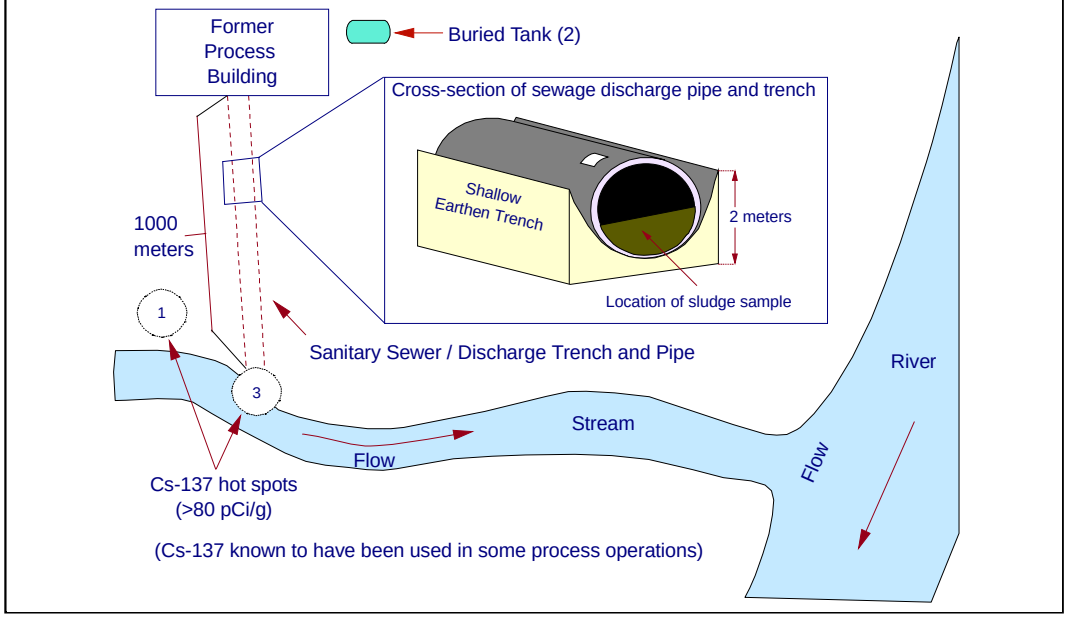
Uncertainty in whether a problem exists requires very specific definition of data needs

A problem may be an actual risk to human health or the environment (e.g., evaluations may indicate that a health-based standard has been exceeded), or a perceived risk (e.g., Pu-239 in soils even if no chance of exposure exists)

There are thresholds that define the conditions under which a current or potential exposure pathway poses an unacceptable risk

An unacceptable condition is a situation that regulations, agreements, or public perceptions delineate as unacceptable, regardless of the actual degree of risk posed

What is the problem(s)?



This slide introduces a concurrent example to help illustrate how to define an environmental restoration problem and how differences in defining a problem can result in major differences in how an environmental restoration project proceeds

Key available background information on the example site includes the following:

•A former process plant was closed five years ago. An old sanitary sewer/discharge pipe (metal) extended from the plant to a stream. The pipe, which lays in a shallow unlined trench, appears intact throughout its length based on a visual inspection

During a limited field investigation of the stream, hot spots of Cs-137 were detected in soils around the pipe discharge (3). Two other samples from the sludge remaining in the pipe at the outfall also showed similarly high concentrations of Cs-137. The concentrations in both the soil and sludge exceed risk-based cleanup standards already agreed to by the core team

Further evaluation also showed a buried tank (2) near the process building and a hot spot of Cs-137 approximately 50 meters west of the pipe and 15 meters from the stream bed (1)

Why focus on problem definition?

- Problems are what you scope, decide to act on, and ultimately remediate
- The process of defining problems identifies information needs
- Problems are not necessarily operable units, release sites, or waste area groups

Uncertainties in problem existence, regulatory issues, technology performance = data gaps = investigation. Information needs include data to establish with sufficient certainty that a condition poses a problem, and data to focus on what response action to take

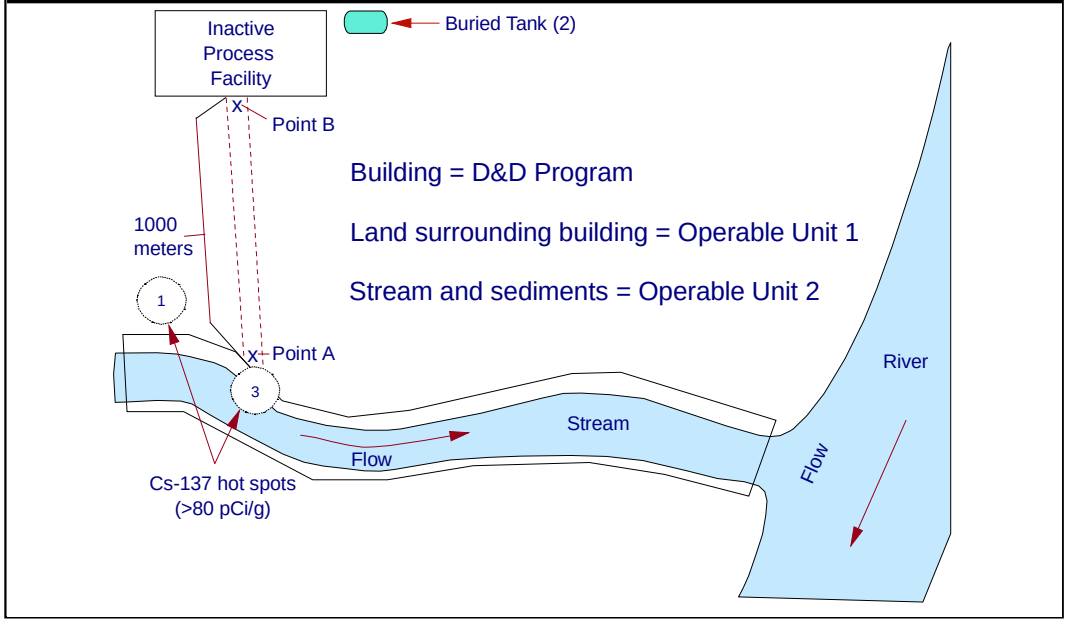
A problem is seldom equal to a SWMU, operable unit, WAG, or release site. Multiple problems may exist within these unit definitions, or problems may exist across unit boundaries

For example, operable units may contain multiple types of waste disposal units, contaminants, media, receptors, and potential exposure pathways. Individual problems must be identified within the unit to be remediated

Likewise, if soil contaminated with a particular contaminant is found throughout several SWMUs, a problem can be defined once, then can be applied to all occurrences of the contaminant in the soil (barring any additional receptors or other factors)

The example on the opposite page poses a common issue with problem definition - OUs may not be defined based on problems, but rather on factors such as geography. The options site managers can use to proceed with investigations, given the constraints of budgets, schedules, and established milestones, are often OU-based

Defining the problem



In this case, the following options may exist:

- Use a removal or interim action
- Reorganize operable units or waste area groups
- Coordinate between the D&D and remediation program activities
- Add a new waste area group (for the pipe and surrounding soils)

Poor problem definition leads to:

- Poor project focus
  - Overly extensive or ineffective investigation (e.g., trying to remove all uncertainties)
  - Extended process to decide on remedy
- Poor project execution
  - Not fixing the problem
  - Fixing the wrong problem
  - Fixing the problem at greater cost than needed
- Prolonged site closeout
- Inappropriate exit strategy

Often, problem definition is not:

•Focused sufficiently on the response aspect of the problem

•Sufficiently based on existing data

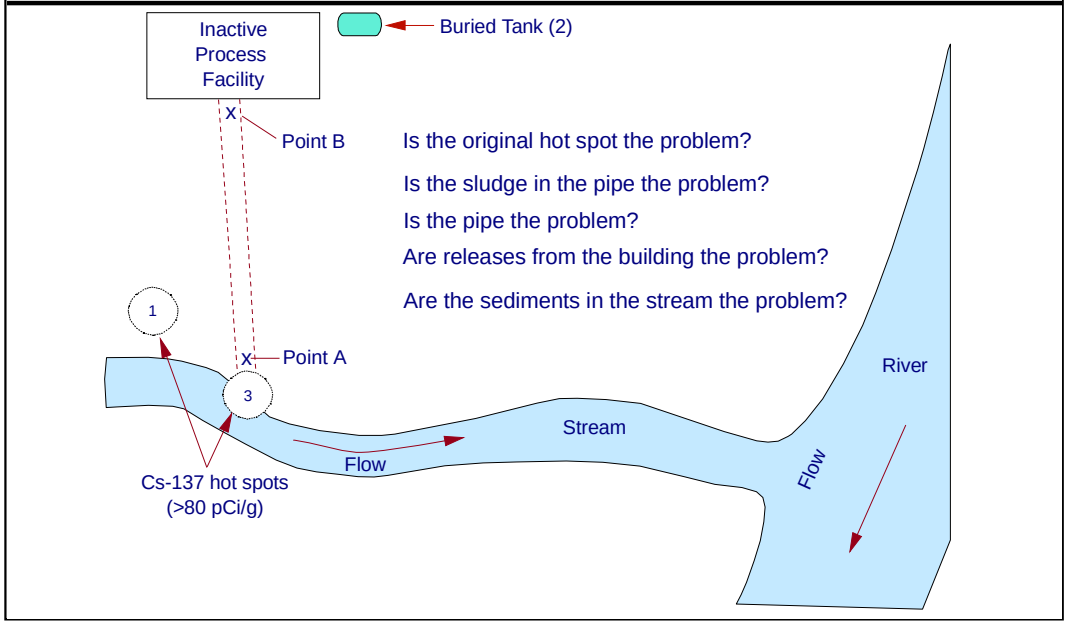
•Performed with rigor needed to focus environmental restoration planning

•Done proactively, with core team involvement and consensus

Often a problem is assumed if contamination is present, setting a default standard of background concentrations as the threshold above which a response is required. This may result in actions that do not significantly contribute to risk reduction

On the next page are a list of different problems that could exist (depending on what subsequent information shows). How the problem is defined will affect the remediation investigation and activities that follow

Impacts of changing problem definition



The activities needed for the hypothetical problem change depending on how the core or project team defines the problem

For example, if the problem is that a continuing source is present in the inactive process facility and is leading to discharge, the activities will be directed toward identifying the source. Much coordination with building operations staff will be needed

If the source is closed off, the pipe contains no sludge beyond the end of the pipe, and the hot spots are from past releases, the decision to act (i.e., remediate the hot spots) may be possible to make immediately

Characteristics of good problem definition:

- Specifies situation requiring response and establishes/clarifies data needs
- Reflects current conceptual site model
  - Modified as information obtained
- Reflects core team consensus
- Helps define data sufficiently
  - Necessary data
  - Sufficient data

The core team is ultimately responsible and accountable for problem definition

If the core team defines something as a problem, it is a problem

Problem definition occurs at all levels on which environmental restoration activities occur:

•Sitewide: What is the focus of my overall site strategy and how should I organize my resources to investigate and remediate areas?

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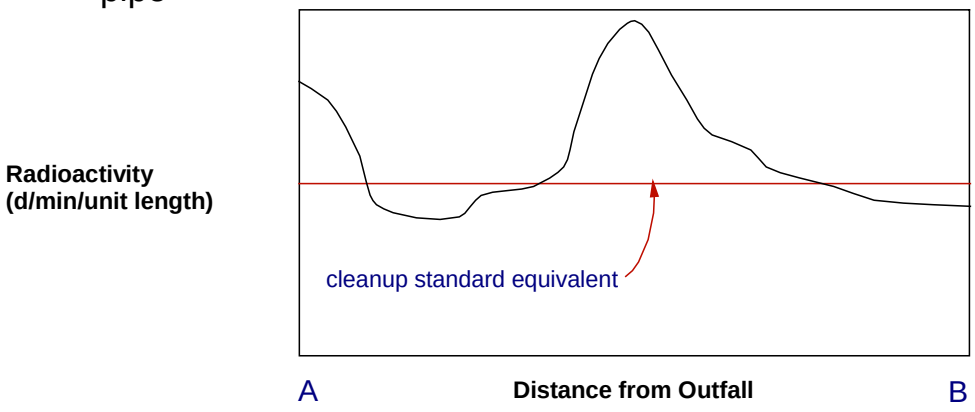
The CSM should not be shelved after the initial scoping of a site. Rather, it should be a "living document" that changes based on new information

Based on the new information derived from a limited field investigation for the hypothetical problem, we will develop a problem statement for our site

Characteristics of good problem definition

- The following graph is based on measurements of radioactivity taken along the exterior, top length of the pipe



A common issue in environmental restoration is in determining whether a problem exists. This often requires two steps: (1) developing a risk-based or other agreeable methodology to define a problematic situation, then (2) applying the methodology to site, operable unit, or release-site situations

Our focus is on the latter of these two tasks

The first part of the task can be done through a variety of techniques: Soil Screening Levels, preliminary remediation goals, action levels, site-specific methodologies, ASTM guidance, contaminant-specific risk assessments, agreements based on existing cleanup levels

In this example, the agreed-to cleanup standard for Cs-137 happens to have already been determined by the core team to be 80 pCi/g, based on a preliminary remediation goal (PRG) methodology for human exposure. The issue for the core or project team, therefore, is to apply this methodology

Documenting problems through problem statements

- Problem statements define the circumstances that require a response
- Key components of a problem statement
  - Media
  - Contaminants and concentrations
  - Volumes
  - Regulatory or other drivers

Problem definition becomes the "If" part of an "If/then" decision rule. A decision rule includes:

•A statement of the unacceptable risk or condition (i.e., the problem)

•The action that will be taken

•When necessary, the data required (or sufficient) to support the decision

Decision rules are an accepted manner of linking together problem statements, likely response actions, and data required to support the decision

Decision rules are a concept used to document what constitutes sufficient information to make a decision. We are focusing on the decision whether to take action (i.e., when a problem exists). The data required to support this decision may vary widely -- from characterization information, to decisions about what concentrations pose a problem, to decisions by the core team about stakeholder concerns

If sufficient information does not exist, it is collected until a decision can be made

However, if sufficient information exists to define that a problem exists, the focus shifts to the response needed to address the problem

Problem statement examples

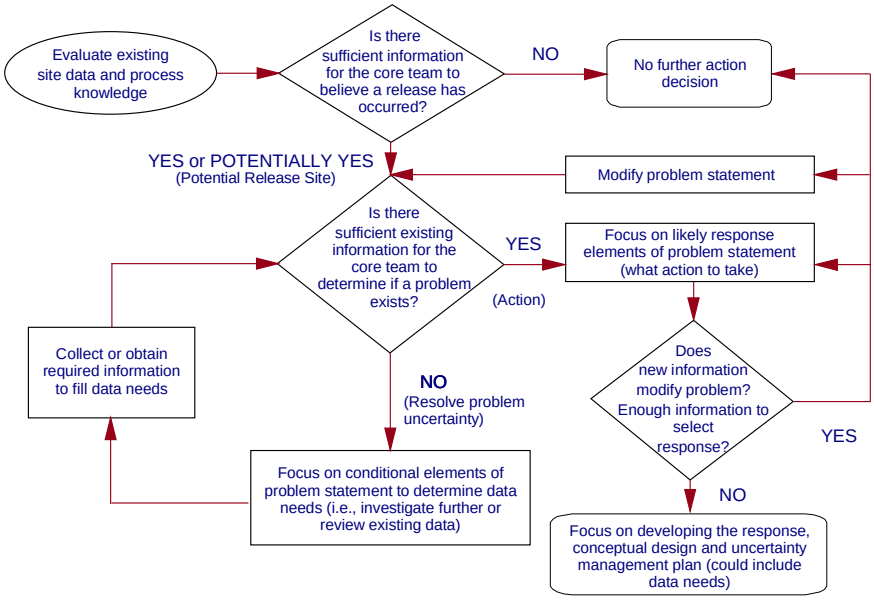
- Sitewide - Cesium-137 found above 80 pCi/g of soil in any 100 square foot area 6 inches deep (measured using standard site protocols) and a total estimated volume of contaminated soil less than 100 cubic meters
- Mixed Cesium-137 and D007 contaminated sludge found in an underground tank that is not in compliance with regulatory requirements

Decision rules link problem statements with likely response actions:

•IF Cesium-137 is found above 80 pCi/g of soil in any 100 square foot area 6 inches deep (measured using standard site protocols) and the total estimated volume of contaminated soil is less than 100 cubic meters, THEN excavate the hot spot, remove to storage area Z, and manage the material as low-level waste

•IF mixed Cesium-137 and D007 contaminated sludge are found in an underground tank that is not in compliance with regulatory requirements, THEN remove the tank and manage the sludge as mixed low-level waste and the tank as mixed waste debris

Problem identification process



This flowchart summarizes the key aspects of problem definition

•Sufficiency of information to define a problem, leading to future focus on remediation

•Importance of considering uncertainty once a problem is defined

•Iterative nature of problem definition

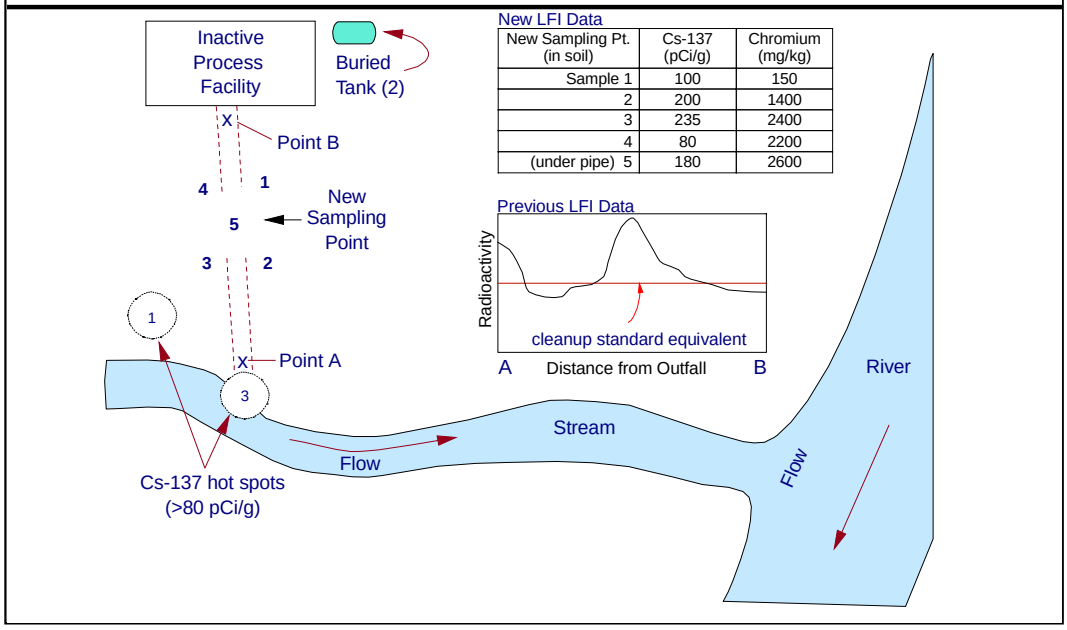
Key underlying aspect to this concept is the conceptual site model

Example on opposite page shows how one major site used this concept to streamline sitewide planning activities

Small group exercise

- Read and follow the directions on the next page
- Take 30 minutes working in your team
- We will report our problem definitions

Now, what is the problem?



New Sampling Pt. (in soil)	Cs-137 (pCi/g)	Chromium (mg/kg)
Sample 1	100	150
2	200	1400
3	235	2400
4	80	2200
(under pipe) 5	180	2600

Based on further field investigation, a project team member found a location where a new section of pipe appeared to have been fitted into an older section, possibly in response to a past release

The project team obtained additional field data using an X-ray fluorescence (XRF) unit to analyze an area of soil discoloration, and found total chromium concentrations at the levels shown. (Note that XRF cannot distinguish between hexavalent and trivalent chromium)

A new sampling point resulted in the additional data shown above

Write a problem statement(s) for this situation